Available online at www.sciencedirect.com
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Procedia Engineering 37 (2012) 214 – 217
Procedia Engineering
www.elsevier.com/locate/procedia

The Second SREE Conference on Engineering Modelling and Simulation (CEMS 2012)

The Simulation of Hierarchical Mobile IPv6 with Fast Handover using NS-2

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Abstract

This paper introduces several main mobile IP technologies, such as MIPv6,FMIPv6,HMIPv6 and F-HMIPv6. F-HMIPv6 is a combination of two mechanisms,FMIPv6 and HMIPv6. We use network simulation tool NS-2 and set a network simulation scenario to simulate F-HMIPv6. The result shows that F-HMIPv6 has good performance.

Keywords: NS-2; Network Simulator; F-HMIPv6.

1. Introduction

The mobile communication has enjoyed a significant growth in recent years. With the growing demand for the development of commercially feasible wireless and cellular mobile communication service, especially for Mobile IP[1] and Mobile IPv6[2], so the interaction between mobility and QoS[3] becomes more important.

Mobile IPv6 (MIPv6) is an IETF standard which is used to increase the mobility management in IPv6 networks. MIPv6 allows Mobile Node(MN) to move and switch between different subnets in the Internet at the network or IP layer without any change of its Home Address (HoA). Thus, the movement of MN away from its home link is transparent to higher-layer protocols and applications.

In MIPv6 system, it contains three functional entities: Mobile Node (MN), Home Agent (HA), and Correspondent Node (CN). MN is the mobile terminal. HA remains at conventional IPv6 subnet called the home link, and when the MN is at the home link then the packets sent to it are routed through

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doi:10.1016/j.proeng.2012.04.229

conventional IPv6 routing mechanisms. When the MN is not at home link it registers its remote point of attachment address called Care-of Address(CoA) with the HA. This allows HA to forward packets which addressed to the MN at its home link to the MN at its current location. CN is a peer node which communicates with a mobile node.

All packets sent to the MN's HoA by CN are routed to the home link when HA is present. The HA maintains a mapping between the CoA and the HoA called the binding. When the MN is visiting a foreign network, the binding cache entry for the MN is activated and the packets arriving for the MN are intercepted by the HA and tunneled (IPv6 in IPv6) to the CoA of the MN.

However, MIPv6 requires mobile nodes to perform the home network registration and an address resolution procedure, which results in long handoff latency and degrades severely the transport protocol performance. The current solution includes: Fast Handover for Mobile IPv6 (FMIPv6)[4], Hierarchical Mobile IPv6 (HMIPv6)[5] and Fast Handover Hierarchical Mobile IPv6 (F-HMIPv6)[6], etc. Since F-HMIPv6 is a joint of FMIPv6 and HMIPv6, it is likely that F-HMIPv6 has advantages of both FMIPv6 and HMIPv6. This paper uses the network simulation tool NS2 to verify the performance F-HMIPv6.

2. Background

2.1. HMIPv6

HMIPv6 plays the role of intra-domain mobility solution. It introduces the Mobility Anchor Point (MAP) entity for each domain. The MAP is a router that maintains a binding between itself and a mobile node currently in its domain. A MN entering a MAP domain will receive Router Advertisement (RA) from the Access Router (AR). These RAs contain information on one or more local MAPs. The MN can bind its current location, LCoA (on-link care of address configured on a mobile node's interface based on the prefix advertised by the access routers; it is a local unique address in a IPv6 subnet), with an address on the MAP's subnet the RCoA (regional care-of-address which is a globally routable address specific to a IPv6 domain). When a MN changes its point of attachment within a MAP domain it needs to register only the LCoA with the MAP since the global address, RCoA associated with that MAP has not changed. Thus handover latency within a MAP domain is greatly reduced as the Binding Updates (BU) needs to reach the MAP only.

2.2. FMIPv6

FMIPv6 allows the anticipation of the layer 3 handoff such that data traffic can be forwarded to the MN's new location before it moves there. This results in reduced packet loss due to the layer 3 handoff latency. Fast handover introduces four new message types to be used along with MIPv6. These messages are used between the MN and the AR and between the Previous access router (PAR, the access router to which MN is attached before handing off) and new access router (NAR, the access router to which mobile node handoffs). These messages are Router Solicitation for Proxy (RtSolPr), Proxy Router Advertisement (PrRtAdv), Handoff Initiation (HI), Handoff Acknowledgement (HAck). Fast handover is initiated by the link layer triggers like signal to noise ratio (SNR) or signal to interference ratio (SIR). If the trigger is at MN then it sends RtSolPr to the PAR. Otherwise if the trigger is at the PAR it transmits a PrRtAdv. The RtSolPr message contains the link layer address. The MN will receive a PrRtAdv in response. From this response, the MN forms the CoA according to IPv6 address auto-configuration. Subsequently, the MN sends a BU to bind its newly formed CoA as the last message before the handover is executed. After receiving the fast BU from the MN the PAR starts forwarding packets, destined for the MN, to the new

CoA of the MN. When the MN switches to the NAR it sends a Neighbor Advertisement (NA) to initiate flow of packets from the NAR.

2.3. F-HMIPv6

The joint operation of the above two schemes called F-HMIPv6 has the potential to provide a low signaling overload, a low delay, due to the Binding Update process (managed by HMIPv6), as well as a reduced latency during the layer 3 handover linked to the move detection and the configuration of the new CoA during the layer 3 handover (forwarded by FMIPv6). Due to the complexity of the required study, our simulation is chosen as the most suitable analysis method. We use network simulator NS-2.

3. Model of simulation in NS-2

3.1. Simulation Environment

Our simulation is based on the Network Simulator NS-2.31[7]. In order to support Mobile IPv6, we add the FHMIP1.3.1 extension[8] which is provided by SeaSon.

3.2. Simulation Scenario

The simulation scenario with all of the participating entities and links is described in Figure 1(a). Both CN and HA are connected to an intermediate node (N1) with 2ms link delay and 100Mbps links. The link between N1 and the MAP is a 100Mbps link with 50 ms link delay. The MAP is further connected to the intermediate nodes N2 and N3 with 2ms link delay over 10 Mbps links. N1 and N2 are connected to PAR and NAR respectively with 2ms link delay over 1 Mbps links. CN and MN are involved in a TCP session in which a bulk data transfer application transfers packets from CN to MN. Five seconds after the simulation is started CN sends the TCP packets to MN. The packet size is 512 bytes and the TCP window size is 32. NAR's position is (85.0,135.0), 70m apart, on (155.0,135.0) it is NAR. The effective coverage of AR is a circle centered at AR itself with 40 meters radius. Because the vertical axis of PAR and NAR are the same, on the center of the connection between them there are 10m duplicate coverage. 10 seconds after the simulation, the simulated mobile node is placed close to PAR, and MN moves straightly to NAR at the speed of 1m/s. The simulation time is set to 80 seconds.

3.3. Results of the simulation

The simulation results are shown in Figure 1(b).

The handover performance can be analyzed by analyzing the acceptance delay of TCP in switching process. In Figure 2(a) we show that TCP sequence numbers increase with time going. It is clearly that at about the 40th second a latency of TCP occurs because of switch.

In addition, we can also analyze the handover property by MN accepting the UDP jitter, as shown in Figure 2(b). We can find that there is a significant shake at about the 40th second.

4. Conclusion

Mobile IPv6 has been a hot point for research. In this paper we introduce several primary kinds of Mobile IPv6 protocol, such as MIPv6、FMIPv6、HMIPv6、F-HMIPv6, and carry out the simulation for

F-HFMIPv6. The results show that F-HFMIPv6 has good handover performance, which provide a foundation for further research.

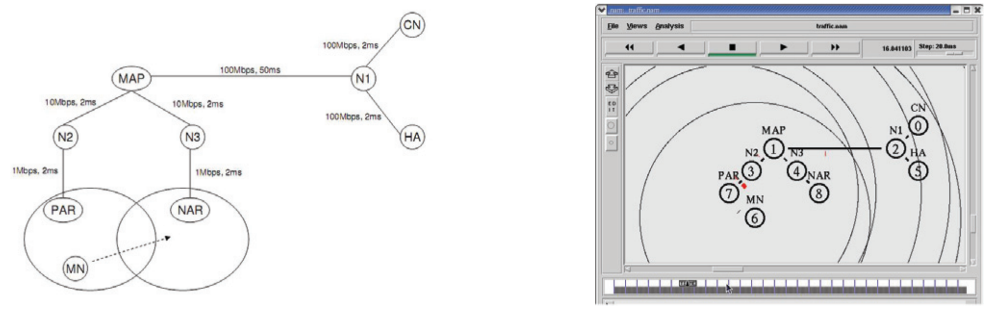

Fig. 1. (a) F-HMIPV6 Simulation topology; (b) F-HMIPV6 Simulation Effect Picture.

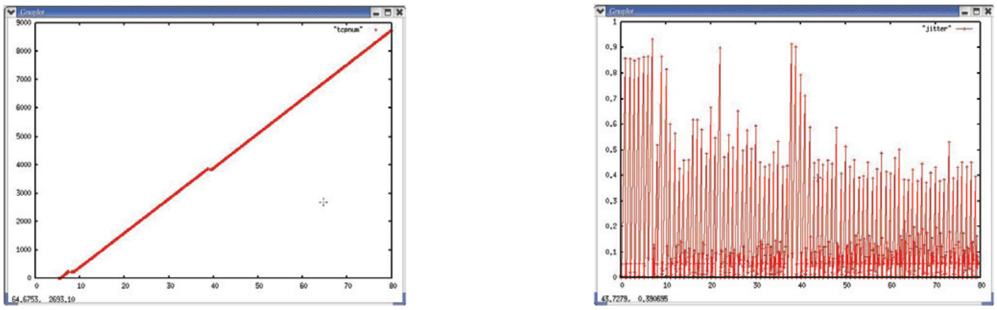

Fig. 2. (a) TCP Number; (b) Jitter.

Acknowledgements

This work is supported by Science and technology Fund of Guizhou Province of China (Grant No. [2011]2111) and Youth Fund of Guizhou Normal University(No.75[2007]).

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